SUMMARY REVIEW OF COSTS AND EMISSIONS INFORMATION FOR 24 CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM PROJECTS

Final Report

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1.0 Overview of Report

This report on the Congestion Mitigation and Air Quality Improvement Program (CMAQ) builds on the extensive program-wide set of CMAQ project data gathered by FHWA.[1] It also expands on work by USEPA on the costs and air quality impacts of the CMAQ program.[2]

The purpose of the report is to determine, for each of a set of 24 individual CMAQ projects, the total annual costs (i.e., CMAQ and non-CMAQ funds), estimated annual emissions reductions, and actual project lifetimes. The projects reviewed are listed in Table One. The projects selected for review, to the extent feasible within the limits of this study, represent the geographic diversity of the CMAQ program and the types of transportation projects that are eligible for CMAQ funding.[3]

The review findings are presented in the following sections of Chapter 1, while Chapter 2 of the report draws conclusions based on the report findings. Appendix A provides an assessment of project cost effectiveness for two sample projects, and Appendix B provides detailed information about individual project emissions estimates.

A Note on Calculating Emission Reduction and Other Benefits of CMAQ Projects: The benefits of the CMAQ program, and particularly projects that promote alternatives to drive alone travel, extend beyond emissions reductions and congestion relief. Many CMAQ projects have ancillary benefits that support other policy initiatives, such as energy conservation, support for welfare to work programs, economic development, and community livability initiatives. This contrasts with other emission control strategies, such as smokestack scrubbers, that generate only air quality benefits.

An accurate estimate of CMAQ project emissions reduction cost effectiveness should reflect these ancillary benefits; however, program-wide data is at present insufficient to

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[1] As summarized in Congestion Mitigation and Air Quality Improvement Program, A Summary of Sixth-Year Activities (FY 1997), FHWA, March 1997 (and previous annual versions)
[2] A Preliminary Assessment of the CMAQ Program's Contribution towards Meeting Ozone Standards, Apogee Research, Inc. 1997 et al.
[3] Inspection and Maintenance projects are not included in this study, as programs are a requirement of the Clean Air Act.

accurately apportion costs between ancillary benefits. Thus, in this report, no assessment is provided of the cost effectiveness of individual projects in terms of air pollutant reductions. A short appendix (Appendix A) to the report; however, provides a discussion of non emissions reduction benefits associated with two of the projects reviewed in this study and an allocation of costs to each ancillary benefit generated by the project allows representative cost-effectiveness ratios to be calculated.

Overview of the CMAQ Program

The CMAQ program was established under ISTEA as a funding source for transportation projects and programs that help support the goals of the 1990 Clean Air Act Amendments. CMAQ funding is apportioned to states based on a legislative formula that takes into account population in areas that do not meet air quality standards, and severity of regional air quality problems. States may use CMAQ funds for a variety of transportation-related measures and programs designed to help meet and maintain the national air quality standards for carbon monoxide and ozone, and in some cases, small particulate matter (PM-10).

Table One: CMAQ Projects Studied

Category	Project Name	State
Shared Ride	Commuter Assistance Program	CA
	Glendale Parking Management Program	CA
	University Rideshare Program	GA
	Park-n-Ride Facility	MD
	Regional Vanpool Program	TX
Bike/Ped	City of Philadelphia Bicycle Network Plan	PA
	Suburban Bike Rack Incentive Program	IL
Traffic Flow	Arterial Street Signal Interconnect	PA
	Signal Systemization Project along MD 2	MD
	Incident Management Program/ATMS	GA
	Signal Interconnection Project	IL
	Extension of HOV Lanes	CT
Transit	Lake Cook Shuttle Bug	IL
	Houston Transit Subsidy	TX
	Light Rail Vehicles	MD
	University City/30th Street Circulator	PA
	Commuter Rail Coaches	MD
	MARTA Intelligent Transportation System	GA
	MARTA Transit Incentives	GA
TDM	Long Island TDM Program	NY
	IEPA Public Education & Outreach	IL
	Atlanta Region TMAs	GA
Other	Fairfax Co. Alternative Fuel Vehicles Program	VA
	Alternative Fuels Refueling Station	GA

CMAQ project selection decisions are made at the state and local level, but are subject to broad Federal guidelines on project eligibility. For purposes of tracking states' CMAQ spending, projects are classified in by the following categories[4]:

- Shared-Ride Services (e.g., park-and-ride facilities, the establishment of vanpool or carpool programs, and programs to match drivers and riders)
- Pedestrian and Bicycle Programs (e.g., development of bicycle trails, storage facilities, and pedestrian walkways, as well as promotional activities)
- Traffic Flow Improvements (e.g., signalization improvements; traffic management/control, such as incident management and ramp metering; and improvements at intersections)
- Transit Improvements (e.g., system/service expansion, replacement of buses with cleaner vehicles, and market strategies)
- Transportation Demand Management Strategies (e.g., promotion of employee trip reduction programs and development of transportation management plans)
- Inspection and Maintenance Programs (e.g., updating inspection and maintenance quality assurance software and training, construction of advanced diagnostic facilities or equipment purchases)
- Other Projects (e.g., conversion of fleets to alternative fuels).

[4] As summarized in Congestion Mitigation and Air Quality Improvement Program, A Summary of Sixth-Year Activities (FY 1997), FHWA, March 1997 (and previous annual versions)

2.0 CMAQ Project Review Findings

The following sections describe the projects reviewed in each of the six CMAQ project funding categories considered as part of this analysis, which include shared ride services, pedestrian/bicycle, traffic flow, transit, Transportation Demand Management, and other projects. For each category, a table that summarizes quantitative findings is presented, accompanied by a brief commentary on findings.

Notes on Presentation of Data:

- ***Project Lifetimes:*** Information on project lifetimes is provided as reported by project contacts. Where such information was unavailable, footnotes indicate that an approximate value has been calculated, based on general transportation planning principles and comparison with similar projects.

- ***Costs:*** Costs for each project are presented in an annualized format to facilitate comparison across projects. Where annualized cost information was not provided by project contacts, annualized project costs were calculated using a 7.0 percent discount rate (typical for public sector infrastructure projects) over the stated project lifetimes.

- ***Emissions:*** The tables present emissions reductions for all projects in tons per year to facilitate ease of data review. In some cases, information supplied by project contacts has been converted from kilograms or pounds per day using appropriate conversion factors and a standard program effectiveness rate of 250 days per year. In most cases, reductions are presented as reported by project contacts; therefore the number of pollutants reported varies from project to project.

- ***National Median Emissions:*** As a point of reference, the FY1997 national median emissions reduction associated with each project category, as reported by FHWA, is provided.[5]

[5] As reported in Congestion Mitigation and Air Quality Improvement Program, A Summary of Sixth-Year Activities (FY 1997), FHWA, March 1997

Shared Ride Projects

Five CMAQ-funded shared ride projects were reviewed for this analysis. Findings are summarized in Table Two. Projects examined include:

- ***Commuter Assistance Program, CA:*** A county-level rideshare program that offers incentives to first time ride-sharers and users of other non drive-alone modes.
- ***Glendale Transportation Management Association (TMA) Parking Management Program, CA:*** A parking management program operated by two employers that uses variable parking prices to encourage non drive-alone modes.
- ***University Rideshare Program, GA:*** A lump-sum eligible to colleges and universities within the 10 county ARC region to provide startup funds for student and staff-based rideshare programs.
- ***Park-and-Ride Facility, MD:*** Construction of additional spaces at a park and ride lot served by transit.
- ***Regional Vanpool Program, TX:*** A region-wide vanpool program operated as a market-driven alternative to the Employer Trip Reduction program.

The shared ride project category contains a diversity of projects. For example, capital projects, like the Maryland park and ride lot expansion, generate long-term air quality and other benefits. Other projects, such as the Commuter Assistance Program, fund annual operating costs, like staff time or incentives, and require annual funding to maintain benefits.

Project Lifetime: The lifetimes of the shared-ride projects reviewed vary from one to thirty years. Three of the five shared ride projects have a one-year life span that is clearly defined by annually recurring operating costs, such as staff salaries or leasing arrangements. The anticipated lifetimes of the two multi-year projects studied are based on general assumptions about anticipated lifetime.

Project Costs: Annualized project costs range in magnitude from $16,125 to $1,699,709. The non-CMAQ share of project funding varies from 20 percent to 69 percent.

Project Emissions Reductions: Annual VOC emission reductions associated with each project range from 0.25 tons to 30.0 tons. Annual NO_x emission reductions associated with each project range from 1.0 tons to 62.0 tons. Appendix B contains detailed descriptions of the methodologies used to estimate emissions reductions.

Other Benefits: In addition to providing air quality benefits, shared ride projects also help reduce congestion and save energy. To the extent that they help reduce vehicle travel, they relieve pressure for highway capacity enhancements, and they support a broad array of environmental goals that are directly linked to reduced vehicle travel, such as stormwater quality.

Lessons learned from Review of Emissions Methodologies:

- Methodologies for developing approximate estimates of shared ride projects are generally straightforward relative to other CMAQ project categories.
- The annual funding required to continue many shared ride projects provides an opportunity to base emissions estimates on actual experience.
- Improved estimates of project lifetimes are needed to accurately annualize the costs associated with annual emissions reductions of multi-year projects.

Table Two: Shared Ride Projects

Project Name	Annual Project Cost[6]		Annual Emissions Reduction (Tons and Year of Estimate)[7]	
Commuter Assistance Program, CA *Project Life: 1 year*	CMAQ Non-CMAQ Total	\$241,250 \$176,193 \$417,443	VOC NO_x CO PM_{10}	2.64 (FY 95/96) 2.64 (FY 95/96) 22.82 (FY 95/96) 1.77 (FY 95/96)
Glendale Transportation Management Association (TMA) Parking Management Program, CA *Project Life: 1 year*	CMAQ Non-CMAQ Total	\$54,500 \$50,000 \$104,500	ROG NO_x CO PM_{10}	4.43 (1995) 5.04 (1995) 38.94 (1995) 3.04 (1995)
University Rideshare Program, GA *Project Life: 10 years[8]*	CMAQ Non-CMAQ Total	\$85,427 \$21,357 \$106,783	VOC NO_x	4.00 (2005) 4.00 (2005)
Park-n-Ride Facility, MD *Project Life: 30 years*	CMAQ Non-CMAQ Total	NA NA \$16,125	VOC NO_x	0.25 (1999) 1.00 (1999)
Regional Vanpool Program, TX *Project Life: 1 year*	CMAQ Non-CMAQ Total	\$528,945 \$1,170,764 \$1,699,709	VOC NOx	30.00 (1997/8)[9] 62.00 (1997/8)[10]

National median emissions reduction[11]:

VOC 1.37 tons/yr.
NOx 1.92 tons/yr.

[6] Multi-year project costs annualized using 7% discount rate.
[7] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[8] Lifetime estimate calculated based on project description provided by project contact.
[9] Based on most recent 12 month calendar time period for which estimates available.
[10] Based on most recent 12 month calendar time period for which estimates available.
[11] National median taken from "CMAQ, A Summary of Sixth Year Activities (FY 1997)," FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

Bicycle and Pedestrian Projects

Two CMAQ-funded bicycle and pedestrian projects were reviewed in this analysis. Findings are summarized in Table Three. Projects examined include:

- ***City of Philadelphia Bicycle Network Plan, PA:*** A comprehensive city-wide bicycle plan
- ***Frankfort-Suburban Bike Rack Program, IL:*** A bicycle rack installation program

In addition to air quality improvements associated with these projects, a range of other benefits are also generated, such as improved quality of life, reduced congestion, and energy savings. The projects in this analysis are thought to be typical of bicycle and pedestrian projects, which are likely to be one-time, capital investments that generate multi-year benefits.

Project Lifetime: A 30-year lifetime is estimated for both of the bicycle/pedestrian projects studied. These estimates are derived from standard transportation planning and engineering assumptions about the lifetime of bicycle facility improvements.

Project Costs: Annualized pedestrian and bicycle project costs in the study range from $26,594 for a site-specific capital improvement, to $298,170 for a coordinated region-wide bicycle planning initiative. The non-CMAQ share of project funding ranges from 20 percent to 45 percent.

Project Emissions Reductions: Annual VOC emission reductions associated with each project range from 0.26 tons to 7.48 tons. Annual NOx emission reductions are calculated for only one project at 6.41 tons per year. Appendix B contains detailed descriptions of the methodologies used to estimate emissions reductions.

Other Benefits: In addition to providing air quality benefits, bicycle and pedestrian projects also help reduce congestion and save energy. To the extent that they help reduce vehicle travel, they also relieve pressure for highway capacity enhancements, and they support a broad array of environmental goals that are directly linked to increased vehicle travel, such as stormwater quality. Bicycle and pedestrian projects may also support enhanced community quality of life.

Lessons learned from Review of Emissions Methodologies:

- Methodologies used to develop emissions estimates for bicycle/pedestrian projects are complex.
- Improved estimates of bicycle/pedestrian project lifetimes are needed to accurately annualize emissions reductions.
- The emissions reduction provided for the Pennsylvania project is for a single year; however, this reduction will be eroded in the long run as the fleet emissions profile improves over time.

Table Three: Bicycle and Pedestrian Projects

Project Name	Annual Project Cost[12]	Annual Emissions Reduction (Tons and Year)[13]
City of Philadelphia Bicycle Network Plan, PA *Project Life: 30 years*[14]	CMAQ: $238,536 Non-CMAQ: $59,634 Total: $298,170	VOC: 7.48 (1994) NO_x: 6.41 (1994)
Frankfort-Suburban Bike Rack Incentive Program, IL *Project Life: 30 years*	CMAQ: $14,506 Non-CMAQ: $12,088 Total: $26,594	VOC: 0.26 (Average over life of project)[15]

National median emissions reduction[16]:

VOC 0.27 tons
NOx 0.27 tons

[12] Multi-year project costs annualized using 7% discount rate.
[13] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[14] Project life estimate based on assumed lifetime of capital improvements described in IL bicycle project.
[15] Emissions reduction was estimated on yearly basis for lifetime of project.
[16] National median taken from "CMAQ, A Summary of Sixth Year Activities (FY 1997)," FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

Traffic Flow Projects

Five CMAQ-funded traffic flow projects were reviewed in this analysis. Findings are summarized in Table Four. Projects analyzed included:

- ***Arterial Street Signal Interconnect, Philadelphia, PA:*** Interconnection of traffic signals along arterials with high transit use to improve traffic flow and to enhance transit quality.
- ***Signal Systemization Project along MD 2, MD:*** Coordination of traffic signals along an arterial in the Baltimore region.
- ***Incident Management Program/ATMS, GA:*** Implementation of an incident management program on Atlanta-region urban highways.
- ***Signal Interconnection Project: Pulaski Rd from Stevenson Expy to 87th St, IL:*** Coordination of traffic signals along an arterial in the Chicago region.
- ***Extension of HOV Lanes on Interstate 84 from East Hartford to Hartford, CT:*** Construction of HOV lanes into Hartford, CT.

The projects studied are all identified as long lasting. The actual lifetime of these benefits, however, is uncertain. In addition to air quality improvements associated with these projects, they also help to ease congestion.

Project Lifetime: Lifetimes for the projects reviewed range from 10 to 20 years. These estimates are derived from standard transportation planning/engineering assumptions about the lifetime of traffic flow improvements and highway facilities.

Project Costs: Annualized traffic flow project costs in the study range from $31,979 for an arterial signal interconnect project in Illinois; to $1,435,894 for extension of HOV lanes in Hartford, Connecticut. The non-CMAQ share of project funding for each project reviewed ranges from 20 to 25 percent of total costs.

Project Emissions Reductions: Annual VOC emission reductions associated with each project range from 3 tons to 3,000 tons. Annual NOx emission reductions associated with each project range from 0.25 tons to 1,000 tons. Appendix B contains detailed descriptions of the methodologies used to estimate emissions reductions.

Other Benefits: In addition to providing air quality benefits, traffic flow projects also help reduce congestion and save energy. To the extent that they help improve vehicle traffic flow, they also relieve pressure for highway capacity enhancements.

Lessons learned from Review of Emissions Methodologies:

- Methodologies for developing approximate estimates are complex and do not take account of induced travel.
- Improved estimates of project lifetimes are needed to accurately annualize the costs associated with annual emissions reductions

Table Four: Traffic Flow Projects

Project Name	**Annual Project Cost**[17]	**Annual Emissions Reduction (Tons and Year)**[18]
Arterial Street Signal Interconnect, Philadelphia, PA *Project Life: 10 years*	CMAQ: $171,227 Non CMAQ: $42,807 Total: $214,033	VOC: 19.00 (1994) NO_x: 2.09 (1994)
Signal Systemization Project along MD 2, MD ***Project Life:*** *12 years*	CMAQ $5,036 Non-CMAQ $1,259 Total $6,295	VOC: 2.92 (2005)
Incident Management Program/ATMS, GA[19] *Project Life: 10 years*[20]	CMAQ $673,047 Non-CMAQ $168,262 Total $841,309	VOC: 165.00 (2010) NO_x: 158.00 (2010)
Signal Interconnection Project: Pulaski Rd from Stevenson Expy to 87th St, IL *Project Lifetime: 20 years*	CMAQ $25,558 Non-CMAQ $6,421 Total $31,979	VOC***:*** 7.60 (Average over life of project)[21]
Extension of HOV Lanes on Interstate 84 from East Hartford to Hartford, CT *Project Life: 20 years*[22]	CMAQ $1,028,883 Non-CMAQ $387,001 Operating $20,000[23] Total $1,435,894	VOC 3.3 NO_x 1.1

National median emissions reduction[24]:

VOC 1.65 tons
NOx 0.55 tons

[17] Multi-year project costs annualized using 7% discount rate.
[18] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[19] Additional capital and operating costs are acknowledged to be associated with the emissions reduction attributed to this project, however, estimation of these costs was beyond the scope of study.
[20] Project lifetime based on estimate of typical lifetime for ITS equipment
[21] Emissions reduction was estimated on yearly basis for lifetime of project.
[22] Project lifetime based on consultation with state DOT highway staff
[23] Annual operating costs based on Hagler Bailly work for Houston-Galveston MPO (assumes $8-10,000/lane mile)
[24] National median taken from “CMAQ, A Summary of Sixth Year Activities (FY 1997),” FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

Transit Projects

Seven CMAQ-funded transit projects were reviewed in this analysis. Findings are summarized in Table Five. Projects analyzed include:

- ***Lake Cook Shuttle Bug, IL:*** An employer-sponsored transit shuttle service operated between a commuter rail stop and a business park in Chicago's suburbs.
- ***Houston Clean Air Action Program/Transit Subsidy, TX:*** A reduced transit fare program targeted to August when ozone readings are typically highest.
- ***Light Rail Vehicles, MD:*** New light rail vehicles for the Baltimore light rail system.
- ***University City/30th Street Circulator, PA:*** A circulating shuttle providing improved access to a hospital in Philadelphia.
- ***Commuter Rail Coaches, MD:*** New, higher capacity, coaches for Maryland's commuter rail service in Washington/Baltimore region.
- ***MARTA Intelligent Transportation System:*** Use of ITS technology to improve transit service in Atlanta.
- ***MARTA Transit Incentives:*** An Atlanta employer-based program through which employees are offered reduced-cost transit cards.

As with shared ride CMAQ projects, there is a contrast between transit projects that fund infrastructure improvements, like purchase of transit equipment, that generate long-term benefits, and projects that fund annual operating costs, like leasing of transit vehicles, and which require annual funding to maintain benefits.

Project Lifetime: Lifetimes for the projects studied range from 1 to 30 years. These estimates are derived from standard transportation planning/engineering assumptions about the typical lifetime of transit improvements and highway facilities.

Project Costs: Annualized transit project costs reviewed in the study range from $31,551 for transit-related ITS to $7,236,659 for new commuter rail vehicles. The non-CMAQ share of project funding ranges from 20 to 96 percent of total costs.

Project Emissions Reductions: Annual VOC emission reductions associated with each project range from 1.1 tons to 29.35 tons. Annual NOx emission reductions associated with each project range from 0.8 tons to 93.2 tons. Appendix B contains detailed descriptions of the methodologies used to estimate emissions reductions.

Other Benefits: In addition to providing air quality benefits, transit projects also help reduce congestion and save energy. To the extent that they help improve vehicle traffic volume, they also relieve pressure for highway capacity enhancements. Transit projects can also help to enhance community quality of life by providing transportation choices and enhancing mobility for those without access to a vehicle.

Lessons learned from Review of Emissions Methodologies:

- Methodologies for developing emission reduction estimates for transit projects are usually straightforward.
- Improved estimates of transit project lifetimes are needed to accurately annualize the costs associated with annual emissions reductions.

Table Five: Transit Projects

Project Name	Annual Project Cost[25]	Annual Emissions Reduction (Tons and Years)[26]
Lake Cook Shuttle Bug, IL *Project Life: 1 year*	CMAQ $312,000 Non-CMAQ $78,000 Total $390,000	VOC: 6.43 (1998)
Houston Clean Air Action Program/Transit Subsidy, TX *Project Life: 2 years*	CMAQ $2,625,000 Non-CMAQ $875,000 Total $3,500,000	VOC: 29.35 (1996) NO_x: 34.75 (1996)
Light Rail Vehicles, MD *Project Life: 30 years*	CMAQ $2,159,716 Non-CMAQ $2,804,407 Operating $2,000,000[27] Total $6,964,122	VOC: 6.19 (1998) NO_x: 20.84 (1998)
University City/30th Street Circulator, PA *Project Life: 1 year*	CMAQ $272,000 Non-CMAQ $68,000 Total Cost $340,000	VOC: 1.1 (1994) NO_x: 0.8 (1994)
Commuter Rail Coaches, MD *Project Life: 30 years*	CMAQ $290,111 Non-CMAQ $6,946,548 Total $7,236,659[28]	VOC: 27.78 (1998) NO_x: 93.20 (1998)
MARTA Intelligent Transportation System *Project Life: 10 years*[29]	CMAQ NA Non-CMAQ NA Total $31,551	VOC: 2 (1999) NO_x: 2.25 (1999)
MARTA Transit Incentives *Project Life: 1 year*	CMAQ $300,000 Non-CMAQ $75,000 Total $375,000	VOC 16.5 (1999) NO_x 16.75 (1999)

National median[30]:
VOC 1.37 tons
NOx 1.92 tons

[25] Multi-year project costs annualized using 7% discount rate.
[26] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[27] Operating costs based on National Transit Database information.
[28] Operating costs assumed to remain unchanged because new (larger) cars replace existing cars.
[29] Project lifetime based on estimate of typical lifetime for ITS equipment.
[30] National median taken from "CMAQ, A Summary of Sixth Year Activities (FY 1997)," FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

Transportation Demand Management Projects

Three CMAQ-funded Transportation Demand Management (TDM) projects were reviewed in this analysis. Findings are summarized in Table Six. Projects analyzed include:

- ***Long Island TDM Program, New York:*** A TDM grant program.
- ***IEPA Public Education & Outreach:*** A multi-media public outreach campaign to educate the public about ozone and transportation
- ***Atlanta Region Transportation Management Associations, GA:*** Seed funding for establishment of TMAs in the Atlanta region.

  Project Lifetime: Lifetimes for the projects studied range from 2 to 12 years. These estimates are derived from general assumptions about the plausible lifetime for non-traditional TDM improvements.

  Project Costs: Annualized TDM project costs in the study range from $293,000 to $450,000. The non-CMAQ share of project funding ranges from 20 to 33 percent of total costs.

  Project Emissions Reductions: Annual VOC emission reductions associated with each project range from 4.48 tons to 25.56 tons. Annual NOx emission reductions associated with each project range from 6.94 tons to 26.5 tons. Appendix B contains detailed descriptions of the methodologies used to estimate emissions reductions.

  Other Benefits: In addition to providing air quality benefits, TDM projects also help reduce congestion and save energy. To the extent that they help improve vehicle traffic volume, they also relieve pressure for highway capacity enhancements.

Lessons learned from Review of Emissions Methodologies:

- Methodologies for developing approximate estimates are usually straightforward.
- Improved estimates of project lifetimes are needed to accurately annualize the costs associated with annual emissions reductions.

Table Six: Transportation Demand Management Projects

Project Name	Annual Project Cost[31]		Annual Emissions Reduction (Tons and Years)[32]	
Long Island TDM Program, New York *Project Life: 5 years*	CMAQ Non-CMAQ Total	\$300,000 \$150,000 \$450,000	VOC NO_x CO	4.48 (average) 6.94 (average) 35.39 (average)
IEPA Public Education & Outreach *Project Life: 2 years*	CMAQ Non CMAQ Total	\$234,400 \$58,600 \$293,000	VOC	25.56 (1998)
Atlanta Region Transportation Management Associations, GA *Project Life: 12 years*[33]	CMAQ Non-CMAQ Total	NA NA \$298,690	VOC NO_x	26.25 (2005) 26.50 (2005)

National median emissions reduction[34]:

VOC 7.15 tons
NOx 12.65 tons

[31] Multi-year project costs annualized using 7% discount rate.
[32] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[33] Project lifetime estimated based on project description information
[34] National median taken from "CMAQ, A Summary of Sixth Year Activities (FY 1997)," FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

Other Projects

Two CMAQ-funded "Other" category projects were reviewed in this analysis. Both projects are alternative fuels-related. Results are summarized in Table Seven:

- ***Fairfax County Alternative Fuel Vehicles Program, VA:*** Support for a revolving loan program to encourage adoption of alternative fueled government fleets.
- ***Alternative Fuels Refueling Station, GA:*** Alternative fuel station located at the site of a future multi-use transfer center.

Project Lifetime: Project lifetimes for projects in this category varied from 5 to 20 years.

Project Costs: Annualized "other" category project costs reviewed vary from $23,598 to $128,140 per project.

Project Emissions Reductions: Annual VOC emissions reductions associated with each project range from 0.02 tons per year to 2.75 tons per year. Annual NOx emissions reductions associated with each project range from 0.02 to 2.0 tons per year.

Other Benefits: NA ("Other" category projects can generate a broad of benefits, depending on the type of project.)

Lessons learned from Review of Emissions Methodologies:

- "Other" category projects may have varied emissions estimate methodologies.

Table Seven: Other Projects

Project Name	Annual Project Cost[35]		Annual Emissions Reduction(Tons and Years)[36]
Fairfax County Alternative Fuel Vehicles Program, VA *Project Life: 5 years*[37]	CMAQ Non-CMAQ Total	NA NA $128,140	VOC 0.02 (2000) NO_x 0.02 (2000)
Alternative Fuels Refueling Station, GA *Project Life: 20 years*[38]	CMAQ Non-CMAQ Total	$18,879 $4,720 $23,598	VOC 2.75 (2005) NO_x 2.00 (2005)

National median[39]:

VOC 1.10 tons
NOx 0.55 tons

[35] Multi-year project costs annualized using 7% discount rate.
[36] Emissions estimates presented as reported, therefore not all projects have estimates for VOC, NO_x, CO and PM_{10}
[37] Project lifetime assumed based on anticipated life of average fleet vehicle.
[38] Project lifetime assumed.
[39] National median taken from "CMAQ, A Summary of Sixth Year Activities (FY 1997)," FHWA, 1999. (Note: All data converted from kg/day to tons/yr, using assumption that projects are effective for 250 days per year)

3.0 Conclusions and Perspectives

Estimating the Impacts of the CMAQ Program — Limitations of Existing Data

Each year states provide basic quantitative information to FHWA about the costs and estimated emissions reduction benefits associated with CMAQ projects. These reports provide a rich source of data for analysis of the CMAQ program; however, as the results of this more detailed review of specific projects reveal, there are limitations on the usefulness of the data, including: a lack of specification of project lifetimes, little or no indication of non-CMAQ project costs (nor of allocation of project costs to the various objectives served by the project), and uncertainty in emissions estimates. These limitations, and findings from the review of CMAQ projects, are discussed in more detail in the following sections.

A. Project Lifetime Information

FHWA's CMAQ data does not include information about project lifetimes. The lifetime over which a project remains active determines, in part, the overall benefits attributable to the program. Key conclusions from the review of CMAQ projects are as follows:

- A Range of project lifetimes exist: Across the small number of projects studied, project lifetimes ranged from one to thirty years, suggesting that there is a wide variation in the duration of CMAQ project benefits. In general, CMAQ projects that fund infrastructure or other capital improvements typically generate benefits over many years, while benefits are limited to a single year for CMAQ projects that provide annual funding for operating expenditures.

- Lifetime estimation techniques are unsophisticated: Information about the length of multi-year project lifetimes was not universally available from project contacts and in many cases had to be estimated specifically for this study.

- CMAQ categories exhibit generally consistent lifetimes: Pedestrian/bicycle projects and traffic flow projects studied were predominantly multi-year projects; while shared-ride projects were frequently one year projects, and other CMAQ project categories included a mix.

Perspective: Collection of project lifetime information from project contacts as part of on-going CMAQ monitoring efforts would assist program evaluation. The development of a set of typical project lifetimes as a reference for CMAQ funding recipients could help to reduce any burden that is imposed by such an additional data requirement.

B. Project Cost Information

As part of its CMAQ data tracking initiative, FHWA annually collects information from the states on the CMAQ portion of project costs; however, no information is collected about non-CMAQ costs associated with project implementation. The non-CMAQ share of total project costs varies from project to project. Generally, federal funding requirements mandate a local “match” equal to at least 20 percent of total project costs. Key conclusions from this review include:

- Federal/non-Federal funding shares vary from typical “80/20” split: Review of complete cost information for a small selection of CMAQ projects suggests that funding for CMAQ projects does not always follow an 80 percent federal and 20 percent local funding split. The local funding share for projects examined was as high as 96 percent.

- Total project costs vary widely: Project costs vary widely within CMAQ categories, for example, within the transit category, annualized costs for the projects reviewed range from approximately $32,000 to over $7 million.

- Limited information available about the operating cost of capital projects: Information about the split between operating and capital costs is not readily available. All the one-year projects reviewed funded operating costs only. Most of the multi-year projects reviewed are assumed to fund capital costs alone; however, these projects are likely to involve some operating costs as well. Determining these additional operating costs will require further study to ensure accuracy.

Perspective: Collection of information about the non-CMAQ share of project cost from project contacts as a part of on-going CMAQ monitoring efforts would assist program evaluation. Some CMAQ projects are intertwined with other state and local programs, however, and adequately defining project boundaries in terms of costs may be challenging.

C. Emissions Reduction Methodologies

FHWA’s project-level emissions reduction estimates from States are not required to be authenticated. Research conducted as part of this study indicates that emission calculation procedures vary from state to state.

- For those projects selected for this study, the sophistication of estimate methodologies was generally adequate: The emissions methodologies used for the projects reviewed varied in sophistication, and emissions techniques are necessarily different for individual CMAQ categories. Though the emissions methodologies reviewed appeared reasonable, they were generally not highly sophisticated. Strengths of some of the emissions methodologies reviewed included consideration of running and hot soak emissions in California projects, use of prior year survey data as basis for estimates on-going projects, and consideration of diverted traffic on some traffic flow analyses. Weaknesses included simple calculation errors on some projects, failure to consider emissions of transit vehicles, and no consideration of induced travel for traffic flow projects.

- Variation in project implementation timeframes makes accurate comparisons difficult: Since the projects studied reflect a variety of implementation timeframes, the emissions estimates are not strictly comparable because they are attributable to different years. In addition, some multi-year projects do not provide emissions estimates for out years.

- **Emissions estimates for multi-year projects:** Over time, due to lower emissions from cleaner future fleets, the emission reduction impacts of CMAQ projects are decreased. For the multi-year projects reviewed, emissions estimates addressed this issue with varying levels of sophistication: Some projects reported an annual estimate for each year of the project's lifetime, others provided one or more estimates based on suitable midpoints, and some provided a single point estimate.

Perspective: Better guidance on emissions calculations will improve program evaluations. Simple guidance enhancements might include establishment of procedures for creating lifetime emission estimates for multi-year projects.

Appendix A
Ancillary Benefits of CMAQ Projects — Two Case Studies

The benefits of the CMAQ program, and particularly projects that promote alternatives to drive alone travel, extend beyond contributions to air quality improvements and congestion reduction. Many CMAQ projects provide ancillary benefits that help to support other transportation-related policies, such as energy conservation, welfare to work, economic development, and community livability initiatives. The complexities of evaluating these benefits are beyond the scope of this project, however, the following two examples describe the kinds of benefits that future assessments may address.

A.1 Shuttlebug Project — Connecting Commuter Rail to Suburban Employers

Project Lead: Transportation Management Association of Lake-Cook

Project Background: The Shuttlebug was started in 1996 as a CMAQ “demonstration” project that used shuttle buses to connect commuter rail riders with suburban employers. Now in its third year of funding, the project has proven to be a success, with increases in daily ridership necessitating a shift from 15-seat to 26-seat buses, and new routes planned.

Metra, the Chicago region’s rail service, has nearly 1.5 million boardings per week. Most of Metra’s riders travel to downtown destinations. For those who work in fast growing suburbs like the Lake Cook Road area however, campus style office and industrial parks often require automobile transportation, even in areas served by rail transit. And as travel grows, traffic corridors such as Lake Cook Road are clogging up quickly.

Growing traffic problems have led several employers in the area to form the Transportation Management Association (TMA) of Lake Cook. The TMA’s support for innovative solutions to congestion provided the catalyst for establishing a free shuttle that connects a new local Metra station to major employers nearby, like Underwriters Laboratories, Walgreens, and Morgan Stanley Dean Witter. In fact, employer contributions help to make up the local match for the CMAQ grant used to meet the cost of operating shuttles. The Shuttlebug also receives support from Metra.

The Shuttlebug is operated by Pace, Chicago’s suburban bus service, and CMAQ funds are used to help cover the cost of operations.[40] The Shuttle Bug serves six routes, and a seventh route is planned. The buses offer high frequency, door-to-door service to about half of the 25,000 employees in the area. Target riders include those who commute out of Chicago to jobs in the suburbs, but significant ridership also comes from suburban residents. The air quality benefits of the Shuttle Bug get a boost because many riders have commutes of more than 15 miles one way. Even more importantly, surveys show that 60 percent of those who take the shuttle previously drove to work alone. Daily ridership now stands at about 550 trips.

[40] CMAQ funding requirements place a limit of 3 years on use of funds for transit operating expenditures.

Qualitative Ancillary Project Benefits:

In addition to the quantified emission reductions, the Shuttlebug project sponsors note a variety of non-quantified ancillary benefits that include the following:

- *1. Increased mobility* — makes suburban jobs accessible to workers without cars.
- *2. Economic development* — employers support the service as a means for attracting workers.
- *3. Congestion relief* — The region affected by the project is experiencing increasing congestion problems.
- *4. More efficient use of transit infrastructure* — The shuttle is generating ridership on the return leg of the region's commuter rail service that would otherwise be empty, thus reducing operating costs.
- *5. Energy efficiency* — The service replaces auto trips with a more energy efficient mode of travel.

Project Cost Effectiveness Adjusted for Ancillary Benefits:

Annual Cost:	$390,000
Annual VOC Reduction:	6.43 tons
Total Number of Benefits:	6
Annual Cost/Benefit:	$65,000
Adjusted Cost/Ton Reduced:	$10,000 (rounded)

A.2 Financial Incentives for Encouraging Ridesharing; Advantage Rideshare Program, Riverside County, California

Project Lead: Riverside County Transportation Commission

Project Background: In Riverside County, California, a suburb of Los Angeles located about six miles north of the city, local officials have created Advantage Rideshare, an innovative financial incentive-based carpool program that helps address the area's traffic problems, caused in part by a regional imbalance of jobs and housing.

As home prices have grown in the region's employment hubs of Orange County and Los Angeles, many workers have opted to live further away in areas like Riverside County and the so-called 'Inland-Empire' is booming with residential development. In fact, one-third of Riverside County commuters travel to workplaces outside the county, causing traffic jams along State Route 91 (SR-91), which provides the only direct access to adjacent counties.

In 1989, Riverside County voters approved "Measure A," which increased the county's sales tax by ½ of 1 percent for 20 years to pay for congestion-related transportation improvements. Advantage Rideshare was begun in 1991, as part of the Measure A initiative and has been operated continuously since.

Advantage Rideshare, is operated by the Riverside County Transportation Commission (RCTS). The program offers a financial incentive to motivate Riverside County residents who currently drive alone to and from work to use alternative modes of transportation. Since the program began the annual budget for the program has been funded from a variety of sources, including CMAQ dollars. The budget covers marketing, administration and the cost of providing financial incentives.

The centerpiece of the program is a subsidy to those who currently drive alone to work and switch to alternative modes who are eligible for $2 in gift certificates – redeemable at a local shopping mall or grocery store — for each day they use another commute mode during their first three months in the program. After six months in the program, participants become eligible for a 'club ride' membership card good for merchant discounts at local area restaurants and business establishments. The Advantage Rideshare program is widely promoted at employers' worksites through customized flyers, rideshare fairs, and presentations to management teams or employees.

A comprehensive tracking study conducted by an RCTS consultant demonstrates the effectiveness of the program — approximately 79 percent of participants continue to rideshare after their first three months and since 1993 over 7,000 commuters have participated in the program. The Advantage Rideshare program was honored by EPA with a 'Way to Go' award in 1996.

Qualitative Ancillary Project Benefits:

In addition to the quantified emission reductions, the Advantage Rideshare project may reasonably be expected to have a variety of non-quantified benefits; these include, but are not limited to, the following:

- *Increased mobility*— Improves travel options for workers without cars.
- *Congestion relief* — The region affected by the project is experiencing increasing congestion problems.
- *More efficient use of highway infrastructure* — The Advantage Rideshare program is one of a number of projects in the region, including an innovative High Occupancy Tolls or "HOT" lane highway that are designed
- *Energy efficiency* — The service replaces single occupant auto trips with a multiple occupant trips.

Project Cost Effectiveness Adjusted for Ancillary Benefits:

Annual Cost:	$417,443
Annual VOC/NOx Reduction:	2.64 tons
Total Number of Benefits:	5
Annual Cost/Benefit:	$83,489
Adjusted Cost/Ton Reduced:	$32,000 (rounded)

Appendix B

(See file attached with e-mail)